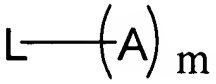
The Examiner points out that U.S. Patent 6,821,645 corresponds to JP '859. In addition, applicants note that U.S. Patent 6,358,634 corresponds to JP '754.

The Examiner asserts that JP '859 discloses light emitting devices comprising a light emitting layer with a phosphorescent iridium compound and a light emitting material. The Examiner additionally states that JP '859 discloses an electron transporting injecting layer comprising Compound C which, according to the Examiner, satisfies formula (E-I) of the present claims. Compound C is employed in Example 15 of JP '859.

The Examiner states that JP '859 does not disclose the specific light emitting metal complex of formula (H-4), which appears in independent claim 9 of the present claims, but does teach that any known light emitting material in the art may be used in the light emitting layer. The Examiner relies on the secondary reference of JP '754 for a teaching of compound (2-1) as a luminescent material which, according to the Examiner, satisfies formula (H-4).

The Examiner argues that it would have been obvious to employ the compound (2-1) of JP '754 as a light emitting material in JP '859 because JP '859 teaches that the light emitting material is used with a phosphorescent iridium material in the light emitting layer.

The present invention is directed to an organic electroluminescent element comprising a pair of electrodes, and an organic layer between the pair of electrodes, the organic layer comprising a light-emitting layer and an electron transporting layer, wherein the light-emitting layer contains at least one phosphorescence-emitting material and at least one metal complex functioning as a host material, and the electron transporting layer contains a compound represented by the formula (E-I):



(E-I)

In formula (E-I)), A represents a monovalent heterocyclic group where two or more aromatic hetero rings are condensed, the heterocyclic groups represented by A is the same or different from each other, m represents an integer of 2 or more, and L represents an m-valent linking group.

Applicants submit that JP 2001-247859 to Igarashi et al and JP 2000-302754 to Igarashi et al do not disclose or render obvious the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

The present invention produces surprising and unexpected effects that support the patentability of the present invention. These effects can be seen by comparing Examples 1-3 and Comparative Examples in the specification of the present application.

The present invention employs a constitution provided with both of high outer quantum efficiency (external quantum efficiency) and durability.

Though there exist infinite combinations of one well-known technique with another well-known one, the cited references neither disclose nor suggest such a constitution which is provided with both of a high outer quantum efficiency and durability.

The present invention resides in the selections which are made to provide these effects, which are illustrated by the following data found in the present application and the following information relating to JP '859 and JP '754.

Comparative Example 1
Host: Compound 58 (metal complex)
Electron transporting layer: Alq (not represented by formula (E-1))
→ Maximum luminance: 3600 cd/m^2,
outer quantum efficiency: 1.77%

Example 1
Host: Compound 58 (metal complex)
Electron transporting layer: E-26 (represented by formula (E-1))
→ Maximum luminance: 23000 cd/m^2,
outer quantum efficiency: 18.8%

Example 2
Host: Compound 58 (metal complex)
Electron transporting layer: E-23 (represented by formula (E-1))
→ Maximum luminance: 36500 cd/m^2,
outer quantum efficiency: 19.2%

Comparative Example 2
Host: Compound 58 (metal complex)
Electron transporting layer: SAlq (not represented by formula (E-1))
→ Maximum luminance: 33000 cd/m^2,
outer quantum efficiency: 15.5%

Example 3 (Experiment for durability comparison)
Example 1: 78 hr
Example 2: 120 hr
Comparative Example 2: 4 hr

Example 15 of JP '859
Host: CBP (not a complex)
Electron transporting layer: a compound represented by formula (E-1)

Compound of JP '754 → Host compound (H-4) of the present application

The outer quantum efficiencies of the elements set forth in Examples 1 and 2 of the present application are 18.8% and 19.2%, respectively.

The outer quantum efficiency of an organic EL element is defined by:

$\phi_{ext.} = \phi_{int.}$ (internal quantum efficiency) x η_{out} (light take-out efficiency).

The light take-out efficiency can be approximated by, with an assumption that the radiation within the light-emitting layer is isotropic,

$\eta_{out} \approx 0.5/(\text{refractive index of the light-emitting layer})^2$.

Since the refractive index of an organic matter is usually around 1.6, the light take-out efficiency becomes roughly 20%.

In a phosphorescence-emitting element, the internal quantum efficiency is 100% at maximum, the theoretical maximum of the outer quantum efficiency is roughly 20%.

Then, the outer quantum efficiencies of the elements in Examples 1 and 2 of the present application are almost equivalent to the theoretical maximum. These facts show that the effect of the present invention is surprisingly high, and support the patentability of the present invention.

In addition, the outer quantum efficiency of the element in Comparative Example 2 is 15.5%, which is fairly high, but the durability of the element is very poor. In contrast thereto, the elements of Examples 1 and 2 exhibit durability far exceeding that of the element in Comparative Example 2.

Namely, the effect of the present invention on simultaneously achieving high quantum efficiency and high durability is tremendous, and establishes the unexpected results that are achieved by the present invention.

Neither JP '859 nor JP '754 teaches or suggests the combination of selections that are necessary to arrive at the present invention, and neither teaches or suggests the surprising and unexpected effects of the present invention.

In view of the above, applicants submit that JP 2001-247859 to Igarashi et al and JP 2000-302754 to Igarashi et al do not disclose or render obvious the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

Claims 1-20 have been rejected under 35 U.S.C. § 103(a) as obvious over U.S. Patent 6,835,469 to Kwong et al in view of JP '859 and in view of JP '754.

Applicants submit that Kwong et al, JP 2001-247859 to Igarashi et al and JP 2000-302754 to Igarashi et al do not disclose or render obvious the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

The Examiner states that Kwong et al discloses an EL device with the required layers at col. 25, lines 3-26. The Examiner states that the light emitting layer is disclosed as comprising a host organic metallic compound suitable in an OLED, as disclosed at col. 24, lines 14-17, and a phosphorescent compound "Irppy" is taught as a dopant at col. 24, lines 24-81.

The Examiner states that Kwong et al disclose that the electron transporting layer may be comprised of any suitable material such as Alq, as set forth at col. 25, lines 31 and 33.

The Examiner states that Kwong et al do not teach a compound of formula (E-1) of the present claims as an electron transporting compound, but do teach Alq as an electron transporting compound. The Examiner argues that it would have been obvious to employ the Compound C of Igarashi et al '859 in Kwong et al to satisfy the recitations of claim 1 of the Compound (E-1).

In addition, the Examiner relies on JP '754 for a teaching of compound (2-1) as corresponding to formula (H-4). The Examiner argues that it would have been obvious to employ the compound (2-1) of JP '754 in Kwong et al as the host material.

As discussed above, the present invention resides in the selections which are made to produce the surprising and unexpected effects of the present invention. As discussed above, neither JP '859 nor JP '754 teaches or suggests the combination of selections that are necessary to arrive at the present invention, and neither teaches or suggests the surprising and unexpected effects of the present invention.

Accordingly, applicants submit that it would not have been obvious to employ the compounds of JP '859 and JP '754 in Kwong et al to arrive at the present invention.

In view of the above, applicants submit that Kwong et al, JP 2001-247859 to Igarashi et al and JP 2000-302754 to Igarashi et al do not disclose or render obvious the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Date: July 20, 2006